MORPHOLOGY OF THE NORTHERN REYKJANES RIDGE AND SOUTHWESTERN ICELAND AS RELATED TO VOLCANOGENIC PROCESSES

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LONG TERM GOALS

Relate the terrestrial and submarine geomorphology of a shallow water mid-ocean ridge system to determine the causative processes for slow spreading (Atlantic type) end member.

SCIENTIFIC OBJECTIVE

- Refine the submarine morphology of the northern Reykjanes Ridge
- Compare marine and terrestrial geomorphology to determine similarities and differences and the underlying constructional processes and causes.
- Merger of data sets to give definitive theories on the origin of the morphology as related vocanogenic and mantle processes.

APPROACH

- Sea floor morphology will be analyzed using geomorphic techniques.
- Petrographic analysis will be undertaken to determine origin of samples and chemical affinities.

ACCOMPLISHMENTS

- Through cooperation with the Icelandic Fisheries Institute five new detailed submarine topographic charts of the Reykjanes Ridge between 63 25 N. and 62 40 N. are now available.
- Sampling of volcanic systems from Eldey Bank (63 28N. to the Hallmundarhraun volcanic complex on Iceland are complete with 50 samples from the marine environment and 618 from land.
- Petrochemical analyses are underway

RESULTS

- Published geological charts of the Hallmundarhraun region were found to be greatly simplified and now will be revised.
- Published bathymetric charts from 62 40 N. to 63 25N have been refined by new data and several new small sea knolls charted.

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- The northernmost western Rift Zone (Langjokull) is an active volcanic zone made up of seven volcanic systems. The last eruption occurred about 1100 years ago. The spreading rate is probably very slow, at least in the northern part of the zone. The northern most Western Rift Zone is unique among the active volcanic zones of Iceland and possibly elsewhere within the Mid Atlantic Ridge system, in being characterized by relatively few but very large eruption units in space and time. The zone has been active in this manner for at least several hundred thousand years.

Individual eruption units of Upper-Pleistocene and Holocene age can display considerable variations in chemical composition in this zone and each unit can cover the main part of the chemical spectre of each volcanic system. This indicates that the chemical variations in these systems may primarily be due to processes active in shallow magma chambers.

The four morphological types, the subaerial pahoehoe lava shields and aa fissure lavas and the sub- or intraglacial tuyas and ridges of the northernmost Western Rift Zone can not be distinguished petrographically or chemically as on the Reykjanes Peninsula. Their morphology depends probably primarily on local tectonics and topography but eruption rate may also be a factor. The same may apply to the northern Reykjanes Ridge; there are no indications of a correlation between morphology and chemistry among the submarine mounds and ridges.

The overall petrography and chemistry of the Western Rift Zone appears to be uniform as based on an investigation of 350 rock samples and 202 new chemical analyses. The Upper-Pleistocene and Holocene extrusives are primarily high-MgO olivine tholeiites.

An investigation of additional 154 chemical analyses from the Reykjanes Peninsula and the northern Reykjanes Ridge clearly demonstrates a shift in the basalt chemistry from e. g. lower MgO and higher SiO2 in the southwest towards higher MgO and lower SiO2 compositions in the northeast, i. e. going inland towards the center of Iceland hot spot. The causative processes for this are unclear at the present time.

Only two of the seven volcanic systems in the northernmost part of the Western Rift Zone have developed a true central volcano during the last approximately 0.7 Ma. One typical central volcano is present on the Reykjanes Peninsular and one is probably in a nascent state. There are no indications of central volcanoes on the northernmost Reykjanes Ridge (63-63 50N), although both morphology and petrology strongly indicate the presence of active volcanic systems on the crest of the ridge, comparable to those on the Reykjanes Peninsula.

IMPACT FOR SCIENCE OR SYSTEM APPLICATION

Too early yet to determine.

TRANSITIONS

Bathymetric data to FIMA

RELATIONSHIP TO OTHER PROJECTS

Program coordinated with Icelandic Fisheries Institute for bathymetry. Petrochemical analyses are coordinated with Nordic Volcanologic Institute. Jim Moore of USGS participated at no cost. The Natural History Museum of Iceland contributed Dr. Jakobsson's salary and partial support for the field work.